>> FUNDING FOR THIS PROGRAM IS PROVIDED BY THE ANNENBERG FOUNDATION/CORPORATION FOR PUBLIC BROADCASTING ELEMENTARY AND HIGH SCHOOL PROJECT FOR MATHEMATICS AND SCIENCE.

>> DO PLANTS HAVE TO BE GREEN?
>> PLANTS ARE LIVING THINGS, SO WHERE DO THEY GET THEIR FOOD?
>> DO PLANTS NEED SUN TO GROW?

>> WELCOME TO "SHEDDING LIGHT ON SCIENCE."
I'M CHRISTINE JONES, AND I OBSERVE THE SKY USING X-RAYS.
SO FAR IN THIS SERIES, WE'VE EXPLORED THE PROPERTIES OF LIGHT.
HOW LIGHT PHOTONS REFLECT FROM SMOOTH AND ROUGH SURFACES, HOW LIGHT PHOTONS MAY REFRACT WHEN THEY PASS FROM ONE MATERIAL TO ANOTHER, AND HOW LIGHT PHOTONS ARE ABSORBED BY MATERIALS.
WE'VE ALSO EXPLORED HOW WE SEE, AND HOW WE SEE COLORS.
WE SEE THE COLORS IN THIS BEACH BALL, BECAUSE PHOTONS ARE REFLECTED FROM THE BALL TO OUR EYES.
WE SEE RED, BECAUSE THE LOWER ENERGY PHOTONS THAT OUR BRAIN INTERPRETS AS RED ARE REFLECTED.
THIS MEANS, OF COURSE, THAT THE REMAINING VISIBLE LIGHT PHOTONS ARE ABSORBED.
SO FOR EACH COLOR ON THIS BALL, SOME OF THE LIGHT IS REFLECTED, AND THE REST IS ABSORBED.
JUST AS NON-LIVING THINGS REFLECT AND ABSORB LIGHT, SO DO LIVING THINGS, LIKE PLANTS.
TODAY WE'LL EXPLORE THE MANY WAYS IN WHICH LIGHT IS IMPORTANT TO PLANTS.
>> AND I'M ANITA GREENWOOD, A

SCIENCE EDUCATOR FROM THE
UNIVERSITY OF MASSACHUSETTS,
LOWELL.
MY WORK INVOLVES HELPING
CHILDREN MAKE SENSE OF THEIR
OBSERVATIONS ABOUT THE WORLD.
LET'S START OUR EXPLORATION AT
THE BEGINNING OF A PLANT'S
LIFE -- WITH A SEED.
WE ALL KNOW THAT IN THE UNITED
STATES, WE GENERALLY PLANT SEEDS
IN THE SPRING AS THE WEATHER IS
GETTING WARMER.
WE PUT THEM IN MOIST SOIL, SO
THAT THEY HAVE A SUPPLY OF
WATER.
BUT WHAT ABOUT LIGHT?
DO SEEDS NEED LIGHT TO GROW?
WE ASKED A GROUP OF TEACHERS IN
LOWELL, MASSACHUSETTS TO TELL US
HOW THEIR CHILDREN HAVE SET UP
EXPERIMENTS TO FIND OUT WHETHER
SEEDS NEED LIGHT TO GROW.

>> Woman: WINDOW SILL IN --
DIRECT LIGHT?
>> Woman: WE TOOK SEEDS AND
SOIL, AND WE PUT ONE IN A WINDOW
WITH LIGHT AND WE WATERED THEM,
AND THEN WE PUT ONE IN A DARK
CLOSET.
>> Greenwood: OKAY, KATHY, GO.
>> ONE CONTAINER WITH SOIL AND
TWO SEEDS WITH LIGHT.
SAME AMOUNT OF WATER AND
TEMPERATURE.
THEN WE'RE GOING TO HAVE ANOTHER
CONTAINER WITH SOIL AND TWO
SEEDS WITH A CARDBOARD BOX
COVERING IT.
SAME AMOUNT OF LIGHT, I'M SORRY,
SAME AMOUNT OF WATER AND
TEMPERATURE.
WE'RE GOING TO OBSERVE THEM
EVERY TWO DAYS AND RECORD IT IN
OUR JOURNALS.
>> WE DECIDED NOT TO USE SOIL,
WE DECIDED TO JUST PUT THEM ON

WET PAPER TOWELS AND PUT THEM IN
PLASTIC BAGS.
AND WE'VE ALL DONE THIS.
AND THIS ONE IS VERY EXCITING
FOR THE KIDS, BECAUSE I THINK
THEY WOULD PROBABLY PREDICT THAT
THEY WOULDN'T GROW.
BUT IT'S VERY EXCITING WHEN ALL
OF A SUDDEN, THEY WOULD OPEN UP
THE PAPER TOWEL, AND THEY'D SEE
THAT ACTUALLY HAD SPROUTED.
I MEAN, I'VE DONE THIS WHERE
THEY'VE PUT IT IN THEIR DESK
OVER THE WEEKEND AND THEN COME
BACK ON MONDAY MORNING, AND THEY
SEE -- IT'S LIKE, WOW, MAGIC.
SO THAT'S WHY WE CHOSE TO DO IT
WITHOUT THE SOIL.
>> Woman: OKAY, THE COLOR IS
DIFFERENT, THE LENGTH IS
DIFFERENT.
>> WELL, THIS ONE JUST BARELY
STARTED.
>> THIS ONE IS YELLOW.
THE LEAVES ON THESE ARE MORE
CLOSED, TOO, AREN'T THEY?
>> SEE HOW THESE ARE OPENED UP
MORE?
>> ALTHOUGH, THIS ONE IS CLOSED,
TOO, BUT THAT'S JUST COMING OUT.
THIS ONE IS JUST COMING OUT.
>> OKAY, PUT THEM STRAIGHT UP.
LET'S SEE IF WE CAN FIND AN
AVERAGE.
>> Greenwood: THE PLANTS THAT
GROW FROM SEEDS AND CONTINUE
GROWING IN THE DARK HAVE VERY
WHITE STEMS WITH SMALL YELLOW
LEAVES.
THE STEMS TEND TO BE LONG AND
SPINDLY.
WE SAY THAT THESE PLANTS ARE
ETIOLATED.
PLANTS GROWING IN THE LIGHT HAVE
STEMS WHICH ARE THICKER, AND THE
LEAVES ARE USUALLY GREEN.
BEFORE WE INVESTIGATE WHY THERE
ARE DIFFERENCES IN PLANTS GROWN

IN THE DARK AND IN THE LIGHT,
LET'S THINK ABOUT WHAT A SEED
NEEDS TO START TO GROW.
SEEDS, LIKE THE PLANTS THAT GROW
FROM THEM, ARE LIVING THINGS.
THAT SEEDS, OR EVEN PLANTS, ARE
LIVING, IS A KEY IDEA FOR YOUNG
CHILDREN TO BEGIN TO UNDERSTAND.
WE VISITED LOWELL,
MASSACHUSETTS, WHERE
PILAR FABERY IS TALKING WITH HER
COMBINATION FIRST AND SECOND
GRADE CHILDREN
ABOUT LIVING THINGS.
>> Woman: WELL, STUDENTS, YOU
HAVE BEEN WORKING VERY HARD ON
YOUR PICTURES ABOUT HABITATS.
I WOULD LIKE FOR YOU TO COME AND
SHARE YOUR PICTURES, AND I'M
GOING TO ASK YOU TO POINT TO THE
THINGS YOU HAVE IN YOUR
PICTURE THAT ARE LIVING THINGS
AND NON-LIVING THINGS.
AND AS YOU SHARE WITH YOUR
CLASSMATES, I'M GOING TO BE
WRITING HERE.
OKAY, AUDREY.
WHAT DID YOU INCLUDE IN YOUR
HABITAT -- FIRST OF ALL, WHAT IS
YOUR HABITAT?
>> A TREE.
>> A TREE.
>> I MADE A BIRD NEST, THE
FATHER, THE TWO BABIES.
AND THIS IS THE MOTHER BRINGING
HOME A WORM.
>> Fabery: OKAY, SO, AS YOU
CONTINUE SHARING, HONEY, I'LL
WRITE A FEW THINGS HERE.
>> AND I MADE THESE TWO
BUTTERFLIES.
>> ARE THERE ANY NON-LIVING
THINGS IN YOUR --
>> ONLY THREE THINGS THAT ARE
THE SAME.
THREE ROCKS.
>> OKAY.
I SEE A RAINBOW IN YOUR PICTURE.

>> THERE'S A FLY IN FRONT OF THE
RAINBOW.
>> MM-HMM, WELL, WHERE WOULD YOU
PUT THE RAINBOW?
LIVING THINGS, NON-LIVING
THINGS?
>> NON-LIVING.
SO THAT'S FOUR THINGS.
>> Fabery: YOU MENTIONED A FEW
DIFFERENT THINGS YOU HAVE
IN YOUR PICTURE, LIKE SHARK,
CRAB, STINGRAY, PEARL.
WHERE -- LET'S LOOK AT THE LIST
OF WORDS I HAVE HERE.
I HAVE ONE LIST THAT HAS
"RABBIT," "BUTTERFLIES," "OWL,"
"BIRDS."
I HAVE A SECOND GROUP, AND IT
HAS THE WORD "TREE" AND THE WORD
"APPLE."
THEN THERE'S A THIRD LIST, AND
IT SAYS, "ROCKS," "RAINBOW."
WHERE WOULD I WRITE THE WORD
"SHARK?"
>> Kids: IN THE RABBITS,
BUTTERFLIES, OWLS, BIRDS.
>> OKAY, I'LL PUT NUMBERS HERE
TO HELP YOU IDENTIFY THE LISTS.
>> Girl: NUMBER ONE.
>> NUMBER ONE.
WHAT ABOUT CRAB?
>> Kids: NUMBER ONE.
>> OKAY.
WHAT ABOUT THE WORD "PEARL?"
>> THREE.
AND I HAVE A TINY LITTLE SNAIL
DOWN THERE.
>> UH-HUH, WHERE WOULD I PUT IT?
>> NUMBER ONE.
>> Girl: SOMETHING GOES IN
NUMBER TWO.
>> Girl: STARFISH.
>> Fabery: WITH TREE AND APPLE?
>> Girl: I SEE A SNAKE IN THERE.
>> Fabery: WHAT DO YOU NOTICE
ABOUT THESE TWO WORDS?
>> Girl: RAINBOW.
>> I GUESS THOSE ARE HOMES.

>> Fabery: YOU SEE THOSE AS
HOMES, THAT'S INTERESTING.
I THINK I HAVE A DIFFERENT RULE
IN MY HEAD, OKAY, FOR PUTTING
THOSE IN THERE.
LET'S SEE IF WE CAN ADD SOME
MORE AND THEN FIGURE OUT WHAT
THE RULE IS FOR GROUP NUMBER
TWO.
MASON.
>> I THINK I KNOW THE RULE FOR
TWO.
>> Fabery: WHAT DO YOU THINK IS
THE RULE FOR NUMBER TWO?
>> NUMBER ONE IS ANIMALS.
NUMBER TWO IS LIVING THINGS THAT
ARE THINGS, NOT ANIMALS, THAT
ARE LIVING THINGS.
AND THE THIRD ONE IS NON-LIVING.
>> Fabery: OKAY, SO ONE AND TWO
ARE LIVING THINGS -- NUMBER ONE
IS ANIMALS, AND NUMBER TWO IS
LIVING THINGS THAT ARE NOT
ANIMALS.
AND THEN NUMBER THREE IS
NON-LIVING THINGS.
WELL, I THINK YOU ARE DEFINITELY
ON THE RIGHT TRACK.
ANYTHING ELSE ABOUT YOUR
PICTURE?
>> Girl: I THINK CLOUDS MIGHT GO
ON TO NUMBER THREE.
>> Fabery: OKAY.
TELL US ABOUT YOUR HABITAT,
MASON, AND THE KINDS OF THINGS
YOU PUT IN THERE.
>> I DID A WATERFALL RIGHT HERE,
AND WHEN I WAS WATCHING TV,
THERE WERE LIKE, ROCKS IN THE
WATERFALL, SO I PUT THREE THERE
THAT I HAVEN'T COLORED IN.
AND I KNEW SALMON WENT IN
WATERFALLS, SO I PUT THE FOUR
SALMON AND TWO BEARS.
>> Fabery: WHY DID YOU PUT BEARS
THERE?
>> BECAUSE I KNEW BEARS ATE
SALMON.

>> Fabery: VERY INTERESTING.
>> AND I MADE A LOG BREAKING ON
THIS ROCK RIGHT HERE.
>> Fabery: OH.
>> IT FELL JUST RIGHT ON THE
WHITE SPOT AND BROKE.
>> Fabery: I SEE.
>> AND I MADE ONE MORE LOG
COMING DOWN THIS WAY.
Fabery: VERY INTERESTING.
NOW, TELL ME ABOUT SOME OF THE
THINGS YOU HAVE IN YOUR PICTURE
AND WHERE SHALL WE PUT THEM?
>> I DON'T KNOW ABOUT LOGS.
>> Fabery: WELL, WHAT DO YOU
THINK ABOUT LOGS?
>> BECAUSE THEY'RE FROM LIVING
THINGS, SORT OF LIKE NESTS.
>> Fabery: THEY'RE LIKE NESTS.
BECAUSE WE MIGHT ASSUME THAT
LOGS ARE ALREADY DEAD BY THE
TIME THEY FALL INTO WATER, INTO
A WATERFALL.
HMM, QUESTION MARK.
YEAH?
>> I DON'T SEE IT DEAD.
>> Fabery: A DEAD LOG?
HMM, I THINK I'VE SEEN SOME DEAD
WOOD LIKE THE ONE YOU WOULD USE
FOR A FIREPLACE.
I THINK.
>> NOT ME.
>> Fabery: NO?
WHAT ELSE, MASON?
>> I PUT A COUPLE TWIGS HERE,
AND I MADE LITTLE TWIGS HERE
FROM THE SMASH, THAT'S SLIVERS
LIKE.
>> Fabery: SO WHAT DO YOU THINK
OF TWIGS THEN?
SHOULD WE PUT THEM IN THE SAME
PLACE WHERE WE PUT LOGS AND PUT
A QUESTION MARK NEXT TO IT?
WHERE WOULD WE PUT THE BEARS?
>> NUMBER ONE.
>> Fabery: NOW, WHAT ABOUT
WATER?
>> NUMBER THREE.

>> OKAY.
>> Mason: BECAUSE THE LAKES
AREN'T LIVING THINGS, WATERFALLS
AREN'T LIVING THINGS.
>> Fabery: WATERFALLS ARE NOT
LIVING THINGS, BUT I HAVE A
QUESTION FOR YOU.
WHAT HAPPENS WHEN THERE ARE
LIVING THINGS INSIDE WATER?
>> Girl: IT'S A HABITAT OR
ECOSYSTEM.
>> Fabery: IT'S A HABITAT OR AN
ECOSYSTEM, SURE, HONEY.
THANK YOU, MASON.
NOW, WHAT ARE THESE LITTLE BLACK
THINGS HERE ON THE BOTTOM?
>> Girl: JUST WORMS.
>> Fabery: THOSE ARE WORMS, TOO,
OKAY, SO IF I ASKED YOU, "WHERE
SHOULD I PUT WORMS?"
WHAT WOULD YOU SAY, LISA?
>> Girl: NUMBER ONE.
>> Lisa: NUMBER ONE.
>> Fabery: NUMBER ONE.
AND I HAVE ONE MORE, THE FLOWER,
LISA, WHERE WOULD WE PUT THE
FLOWER?
>> Lisa: NUMBER TWO.
>> Fabery: NUMBER TWO.
>> Girl: ONE, ONE!
>> Fabery: FOR A FLOWER, NUMBER
ONE?
>> Girl: FLOWERS ARE LIVING
THINGS.
>> Fabery: IT IS A LIVING THING,
A TREE, AN APPLE, A PALM TREE,
GRASS -- ALL THOSE ARE LIVING
THINGS, ALSO.
I THINK EVERYONE IS DONE.
YOU HAVE ALL DONE A GOOD JOB.
I KNOW SOME OF YOU NEED TO
FINISH YOUR PICTURES.
BUT THIS ALSO SHOWS ME THAT
YOU HAVE DEFINITELY LEARNED
A LOT ABOUT HABITATS.
YOU HAVE LEARNED ABOUT LIVING
AND NON-LIVING THINGS IN THOSE
HABITATS, AND WE STILL HAVE SOME

QUESTIONS.
WE HAVE A QUESTION ABOUT THE SUN, WATER, NESTS, LOGS, TWIGS, EGG.
WE NEED TO FIND OUT WHETHER WE SAY "CAT TAILS" OR "CAT FUR."
SO WE'LL CONTINUE INVESTIGATING THOSE QUESTIONS, BUT YOU'VE DONE A REALLY GOOD JOB FOR NOW.
>> WE SEE FROM WATCHING PILAR'S CHILDREN, THAT CLASSIFYING INTO DISCREET CATEGORIES IS OFTEN HARD TO DO.
OBJECTS LIKE NESTS THAT ARE MADE FROM SOME ANIMAL OR PLANT MATERIAL MAY BE CONFUSED FOR LIVING THINGS.
A PEARL THAT AN ANIMAL HAS MADE IS CLEARLY NOT ALIVE TO AN ADULT.
BUT BECAUSE IT'S INSIDE A LIVING THING, CHILDREN HAVE DIFFICULTY CATEGORIZING IT.
CHILDREN THINK OF LIVING THINGS AS THINGS THAT MOVE.
THEY ALWAYS IDENTIFY ANIMALS AS LIVING, BUT NOT ALWAYS PLANTS.
EVEN IF THEY THINK OF PLANTS AS LIVING, THEY ARE NOT ALWAYS SURE ABOUT SEEDS.
THIS IS NOT SURPRISING, SINCE THEY SEE NO EVIDENCE OF THE SEED DOING ANYTHING UNTIL IT'S PLANTED.
SEEDS AND THE PLANTS THAT GROW FROM THEM ARE LIVING THINGS.
AND LIKE YOU AND ME, THEY NEED FOOD.
FOOD PROVIDES ENERGY, AS WELL AS PROVIDING MATERIALS FOR CREATING MORE CELLS.
THE LOWELL TEACHERS DESCRIBED SEEDS GROWING SUCCESSFULLY ON MOIST PAPER TOWELS, OR IN PLASTIC BAGS.
SO WE KNOW THAT SEEDS DO NOT HAVE TO BE IN THE SOIL TO START GROWING.

SO WHERE DOES A NEW PLANT GET
IT'S FOOD TO START GROWING?
LET'S LOOK AT SOME SEEDS TO SEE
IF WE CAN GET ANY CLUES.
ON THE OUTSIDE OF THE BEAN, WE
CAN IDENTIFY A PROTECTIVE COAT.
AND THIS IS THE SCAR WHERE THE
SEED WAS ATTACHED TO THE BEAN
POD.
IF WE MAKE A CUT ALONG THE BACK
OF THE SEED, IT OPENS INTO TWO,
NEAT HALVES.
AND HERE YOU CAN SEE THE NEW
ROOT AND THE NEW SHOOT.
BUT THE BULK OF THE SEED DOESN'T
HAVE MANY FEATURES.
IN THIS AREA ARE THE COTYLEDONS.
AND THERE ARE TWO OF THEM IN
THIS TYPE OF SEED.
SO WHERE IS THE FOOD FOR THE
GROWTH OF THE NEW PLANT?
WE CAN ANSWER THIS QUESTION BY
TESTING PARTS OF THE SEED FOR
STARCH.
STARCH IS ONE OF THE WAYS IN
WHICH PLANTS STORE FOOD.
WE TEST FOR STARCH USING AN
IODINE SOLUTION.
WHEN USING CHEMICALS, WE SHOULD
ALWAYS WEAR SAFETY GLASSES.
TO SHOW THE STARCH TEST, LET'S
USE BREAD FIRST.
WHEN WE TEACH ABOUT THE FOOD
GROUPS, WE PUT BREAD IN THE
CEREALS AND STARCH CATEGORY.
SO IF I PUT BROWN IODINE
SOLUTION ON THIS BREAD...
WE SEE A BLACK COLOR SHOWING
THAT IT CONTAINS STARCH.
NOW, IF I PUT IODINE SOLUTION ON
THIS SEED AND WAIT AWHILE...
WE SEE THAT THE COTYLEDON
BECOMES BLACK.
THE ROOT DOES NOT, AND NEITHER
DOES THE LITTLE SHOOT.
IT'S THE COTYLEDON THAT STORES
THE STARCH.
AND THE YOUNG PLANT WILL NEED

THIS TO START GROWING.
SO NOW WE'VE SEEN THAT SEEDS
HAVE THEIR OWN FOOD SOURCE.
BUT HOW DOES THE FOOD GET INTO
THE SEED?
>> BEFORE WE ANSWER THE
QUESTION, HOW DOES FOOD GET INTO
A SEED, LET'S LISTEN TO
CHILDREN'S EXPLANATIONS OF HOW
PLANTS GET THEIR FOOD.
WE ASKED FOURTH GRADERS AT THE
MURKLAND ELEMENTARY SCHOOL IN
LOWELL, MASSACHUSETTS JUST THAT.
>> OKAY, I HAVE THIS.
>> Boy: I ALSO THINK CARBON
DIOXIDE.
>> HOW SHOULD WE DRAW THE SUGAR?
>> A SQUARE?
>> YEAH.
>> THE SUGAR MAKES THE --
>> OKAY, GOOD, YOU CAN CHECK OFF
ROOTS, YOU CAN CHECK OFF STEM.
WHAT ELSE DID YOU TALK ABOUT?
FOOD?

>> Boy: THE PLANTS MAKE FOOD
WITH MINERALS.
>> THE SUN GOES INTO THE STEM
AND THEN THE LEAVES.
>> THE SUGAR GIVES THEM ENERGY
TO GROW.
>> THE SUN IS GOING INTO THE
LEAVES TO HELP THE FLOWER MAKE
FOOD.
>> Woman: AND WHO'S POSTER IS
THIS?
>> SARA'S.
>> SARA AND SHAUNA.
>> Sara: STEP ONE, ROOTS TAKE IN
MINERALS FROM THE SOIL.
>> Shauna: STEP TWO,
THE MINERALS GO UP THE LEAF.
>> Sara: STEP THREE, THE LEAVES
TAKE IN THE SUN, WATER,
AND CARBON DIOXIDE.
>> Shauna: STEP FOUR, IT GIVES
OUT OXYGEN AND MAKES SUGAR.
>> Sara: STEP FIVE,

SUGAR TRAVELS THROUGH THE STEM
TO OTHER PARTS OF THE PLANT.
>> Shauna: STEP SIX, SUGAR
ALSO TRAVELS TO THE PETALS WHERE
THE POLLEN IS.
>> Boy: FIRST THE PLANT GETS
WATER AND MINERALS FROM THE
SOIL.
STEP TWO, THE PLANTS ALSO GET
SUNLIGHT.
>> THE PLANT COLLECTS CARBON
DIOXIDE.
STEP FOUR, THE LAST STEP IS THAT
ALL OF THE INGREDIENTS ARE MIXED
TOGETHER AND SPREAD OUT
THROUGHOUT THE FLOWER.
STEP ONE, THE PLANTS SUCK IN
WATER FROM THE ROOTS.
>> Woman: COULD YOU POINT --
WHICH PICTURE SHOWS THAT?
>> RIGHT HERE.
>> THANK YOU.
>> STEP TWO, THE WATER GOES UP
THE STEM.
>> STEP THREE, THEN IT GOES INTO
THE LEAVES.
>> STEP FOUR, THERE'S HOLES IN
THE LEAVES TO TAKE IN CARBON
DIOXIDE.
STEP FIVE, THEN THEY MIX CARBON
DIOXIDE WITH WATER AND SUN TO
MAKE SUGAR.
>> STEP SIX, THE SUGAR GIVES
THEM ENERGY TO GROW.
STEP SEVEN, THEN THE PLANT
GROWS.
>> Woman: NICE JOB.
[APPLAUSE]
>> SOME OF THESE FOURTH GRADERS
KNOW THAT PLANTS MAKE THEIR OWN
FOOD, AND THEY CAN NAME THE
INGREDIENTS THAT GO INTO MAKING
THE FOOD.
BUT OTHER CHILDREN BELIEVE THAT
SOIL IS THE SOURCE OF FOOD FOR
PLANTS.
THIS IDEA IS QUITE LOGICAL AND
MIRRORS THE IDEAS OF EARLY

SCIENTISTS.
IN THE 17th CENTURY, MANY PEOPLE ASSUMED THAT THE FOOD NEEDED BY PLANTS FOR THEIR GROWTH CAME FROM THE SOIL.
TO TEST THIS IDEA, A BELGIAN PHYSICIAN NAMED
JEAN BAPTISTE VAN HELMONT PLANTED A YOUNG WILLOW TREE WEIGHING FIVE POUNDS IN A POROUS POT CONTAINING 200 POUNDS OF DRIED SOIL.
HE EMBEDDED THE POT WITH ITS TREE IN THE GROUND AND SOAKED THE SOIL.
THEN HE COVERED THE POT SO THAT NO SOIL COULD ENTER OR LEAVE.
RAINWATER COULD SEEP IN FROM THE GROUND THROUGH THE WALLS OF THE POT TO KEEP THE SOIL MOIST.
VAN HELMONT HYPOTHESIZED THAT IF THE PLANT'S FOOD WAS COMING FROM THE SOIL, THEN THE TREE SHOULD GET HEAVIER AS THE SOIL BECAME LIGHTER.
AFTER FIVE YEARS, VAN HELMONT WEIGHED THE TREE AND FOUND THAT IT WEIGHED 169 POUNDS.
HE THEN DRIED THE SOIL IN THE POT AND FOUND THAT IT WEIGHED 199 POUNDS AND 14 OUNCES.
THE SOIL HAD ONLY LOST TWO OUNCES, BUT THE TREE HAD GAINED 164 POUNDS.
VAN HELMONT CONCLUDED THAT THE FOOD RESPONSIBLE FOR THE TREE'S GROWTH COULD NOT HAVE COME FROM THE SOIL.
INSTEAD, HE CONCLUDED THAT THE WATER IN THE SOIL WAS THE SOURCE OF THE TREE'S FOOD.
VAN HELMONT WAS PARTIALLY CORRECT.
THE WATER IS IMPORTANT, BUT HE DIDN'T HAVE ALL OF THE PIECES OF THE PUZZLE.
LET'S CONTINUE OUR INVESTIGATION OF HOW PLANTS MAKE FOOD.

EARLIER, WE SAW THAT PLANTS
GROWN IN LIGHT ARE GREEN.
THIS GREENNESS IS IMPORTANT IN
THE PROCESS OF MAKING FOOD.
SO LET'S EXPLORE WHAT THIS GREEN
COLOR IS BY LOOKING AT SOME
PLANT CELLS.
>> THIS IS THE POND WEED ELODEA.
YOU'VE PROBABLY SEEN IT IN HOME
AQUARIUMS.
ELODEA IS EASY TO USE, BECAUSE
THE LEAVES ARE THIN, AND YOU CAN
SEE THE CELLS EASILY UNDER THE
MICROSCOPE.
SO IF I TAKE OFF ONE OF THE
LEAVES FROM THE PLANT AND PUT IT
ON A MICROSCOPE SLIDE AND LOOK
AT IT UNDER THIS MICROSCOPE.
NOW, WHEN WE DO THIS, YOU CAN
SEE SMALL, ROUND STRUCTURES
INSIDE EACH CELL.
THESE ARE CALLED CHLOROPLASTS.
EACH CHLOROPLAST CONTAINS
THOUSANDS OF MOLECULES OF A
CHEMICAL CALLED CHLOROPHYLL.
IT IS THIS CHEMICAL THAT GIVES
THE GREEN COLOR TO PLANTS.
NOW, LET'S LOOK AT CELLS FROM
THIS ONION.
AN ONION, AS YOU KNOW, GROWS
UNDERGROUND WITH NO LIGHT.
NOW, IF I MAKE A CUT INTO THE
ONION...
AND PEEL BACK A LAYER OF CELLS
AND PUT THEM ON THE MICROSCOPE
SLIDE AND LOOK AT THOSE UNDER
THE MICROSCOPE...
NOW, WHEN WE LOOK AT THESE
CELLS, THERE ARE NO
CHLOROPLASTS, BECAUSE THERE IS
NO CHLOROPHYLL.
SO WHEN WE LOOK AT THE CELLS OF
A PLANT THAT'S BEEN EXPOSED TO
THE LIGHT, LIKE MY POND WEED, WE
DO SEE CHLOROPHYLL.
AND CHLOROPHYLL MAKES A PLANT
LOOK GREEN.
THE CHLOROPHYLL IS ONLY MADE IN

CELLS WHEN THEY ARE EXPOSED TO
LIGHT.
SO NOW WE KNOW WHY THE PLANTS
THAT THE TEACHERS EXAMINED
EARLIER WERE WHITE OR YELLOW
WHEN THEY WERE GROWN IN THE
DARK.
THEY HAVE NO CHLOROPHYLL.
AND EVEN IF YOU SEE PLANTS WITH
RED LEAVES, LIKE THESE, IT
DOESN'T MEAN THAT THERE IS NO
CHLOROPHYLL.
THESE LEAVES JUST HAVE
ADDITIONAL CHEMICALS WITH THE
CHLOROPHYLL.
EARLIER, WE SAW THAT PLANTS IN
THE DARK WERE VERY LONG.
THIS IS AN ATTEMPT TO REACH THE
LIGHT.
JUST LIKE THIS GERANIUM PLANT.
THE GERANIUM PLANT IS LONG AND
SPINDLY AND BENDING TOWARD THE
WINDOW.
THIS IS AN ATTEMPT TO REACH THE
LIGHT.
WHY IS LIGHT IMPORTANT TO THE
PLANT?
AND WHY DO THEY CONTAIN
CHLOROPHYLL?
WE VISITED CHERYL LOWE, A
HORTICULTURALIST AT THE NEW
ENGLAND WILDFLOWER SOCIETY'S
GARDEN IN THE WOODS IN
FRAMINGHAM, MASSACHUSETTS.
SHE TALKED WITH US ABOUT THE
IMPORTANCE OF LIGHT IN
CHLOROPHYLL TO PLANTS IN THE
PROCESS CALLED PHOTOSYNTHESIS.
>> I'VE WORKED AT THE WILDFLOWER
SOCIETY FOR ABOUT NINE YEARS,
AND I'M THE HORTICULTURE
DIRECTOR, WHICH IS THE
EQUIVALENT OF THE GARDEN
DIRECTOR.
SO I'M IN CHARGE OF ALL THE
DIFFERENT EXHIBITS, THE PLANT
EXHIBITS, BOTH DESIGN AND
INSTALLATION MAINTAINING --

WEEDING, WATERING, EVERYTHING
THAT GOES WITH MAINTAINING A
GARDEN.
GARDEN IN THE WOODS IS THE
BOTANIC GARDEN FOR THE
NEW ENGLAND WILDFLOWER SOCIETY.
IT'S DESIGNED IN A NATURALISTIC
STYLE, WHICH MEANS WE TAKE
INSPIRATION FROM NATURE.
THE PLANTS ARE MIXED TOGETHER
RATHER THAN IN FORMAL LINES.
WE MIX TREES AND SHRUBS AND
LOW-GROWING THINGS TOGETHER.
THE PATHS TEND TO WIND IN GENTLE
CURVES.
PHOTOSYNTHESIS IS, BASICALLY,
THE PROCESS OF CONVERTING LIGHT
INTO FOOD ENERGY THAT PLANTS CAN
USE.
IN THE PROCESS OF
PHOTOSYNTHESIS, THE PLANT USES
THE ENERGY FROM THE SUNLIGHT,
AND THE PLANT USES SEVERAL
THINGS TO MAKE STARCH.
IT USES THE ENERGY FROM THE
SUNLIGHT AND CARBON DIOXIDE AND
WATER.
CHLOROPHYLL IS THE ACTUAL
COMPOUND WITHIN THE PLANT THAT
ABSORBS THE SUNLIGHT.
THE CARBON DIOXIDE THAT A PLANT
NEEDS COMES FROM THE AIR.
THERE ARE OPENINGS IN THE LEAVES
WHERE THE AIR COMES INTO THE
INSIDE OF THE LEAF AND IS
ABSORBED BY THE CELLS.
WATER MOSTLY COMES FROM THE
ROOTS OF PLANTS.
IT'S ABSORBED BY THE TINY ROOT
HAIRS AT THE TIPS OF THE ROOTS
AND THEN TRANSPORTED UP INTO THE
PLANT.
IN ADDITION TO THE SUGARS AND
STARCHES THAT ARE PRODUCED BY
PHOTOSYNTHESIS, OXYGEN IS ALSO
PRODUCED, AND IN SOME WAYS IS
PROBABLY ONE OF THE MOST
IMPORTANT PRODUCTS, BECAUSE THAT

SUPPORTS THE REST OF LIFE ON
EARTH.
>> AS CHERYL EXPLAINS, PLANTS
MAKE THEIR OWN FOOD IN A PROCESS
CALLED PHOTOSYNTHESIS.
THEY DON'T GET FOOD FROM THE
SOIL.
HOWEVER, THEY DO GET NUTRIENTS,
SUCH AS MINERALS, FROM THE SOIL.
SO WHEN WE BUY PLANT FOOD, WE
ARE ADDING MINERALS.
MINERALS ARE NEEDED, BUT THEY
ARE NOT FOOD.
A FOOD CONTAINS ENERGY, AND
MINERALS DON'T SUPPLY ENERGY.
>> THE FOOD A PLANT MAKES IS
SUGAR, AND THE INGREDIENTS
NEEDED TO MAKE THE SUGAR ARE
CARBON DIOXIDE FROM THE AIR AND
WATER FROM THE SOIL.
BUT TO JOIN THESE INGREDIENTS
TOGETHER, THE PLANT NEEDS
ENERGY.
AND THIS ENERGY COMES FROM
LIGHT.
PHOTONS OF LIGHT ENERGY ARE
ABSORBED BY CHLOROPHYLL IN THE
CHLOROPLASTS.
THE ENERGY IS USED TO JOIN
CARBON DIOXIDE FROM THE AIR TO
HYDROGEN FROM THE WATER AFTER A
LOT OF INTERMEDIATE REACTIONS.
THE RESULT OF THIS PROCESS IS
THAT THE PLANT MAKES SUGAR FOR
ITS OWN USE AND MAKES OXYGEN --
A BY-PRODUCT THAT IS RELEASED
INTO THE EARTH'S ATMOSPHERE.
IN PHOTOSYNTHESIS, THE LIGHT
ENERGY IS TRANSFORMED INTO
CHEMICAL ENERGY WHEN THE PLANT
MAKES SUGAR.
>> SO PLANTS MAKE SUGAR.
BUT OFTEN, SO MUCH SUGAR IS MADE
THAT IS CHANGED INTO STARCH FOR
STORAGE AND FOR LATER USE.
WE TESTED A SEED FOR THE
PRESENCE OF STARCH BY USING
IODINE SOLUTION.

TO CHECK IF A PLANT IS
PHOTOSYNTHESIZED, WE CAN TEST
ITS LEAVES TO SEE IF THEY
CONTAIN STARCH.
WHEN WE TESTED FOR STARCH IN THE
SEED, WE SIMPLY PUT IODINE
SOLUTION ON IT.
BUT BECAUSE THE LEAF'S GREEN
COLOR STOPS US FROM SEEING ANY
COLOR CHANGE, WE MUST TAKE THE
GREEN CHLOROPHYLL OUT OF THE
LEAF BEFORE WE CAN TEST IT.
OUR LOWELL, MASSACHUSETTS
TEACHERS DID THIS STARCH TEST
WITH GERANIUM PLANTS.
SOME PLANTS HAD BEEN KEPT IN THE
LIGHT.
OTHERS HAD BEEN KEPT IN THE
DARK.
WHAT DO YOU THINK WILL HAPPEN
WHEN THEY TEST FOR STARCH USING
A LEAF FROM A PLANT IN THE DARK,
AND A LEAF FROM A PLANT IN THE
LIGHT?
>> DO THESE LOOK LIKE THEY'RE
READY?
>> WELL, THIS ONE CERTAINLY
DOES, LOOK AT THE GREEN IN THAT.
AND WHEN YOU LOOK THROUGH IT,
YOU CAN TELL THAT A LOT OF THAT
CHLOROPHYLL HAS COME OUT.
>> OH, WOW, LOOK AT ALL THAT
GREEN.
>> YEAH, BECAUSE THAT WAS REALLY
DARK, DARK.
>> AND NOW WE HAVE TO SWISH THEM
IN THE BOILING WATER.
>> MM-HMM.
>> HOLD ON TIGHT, BECAUSE WE DO
TRY TO TEND TO -- WE WANT TO TRY
TO GET AS MUCH CHLOROPHYLL AS WE
CAN.
AND A LEAF.
REALLY STRIPPED OF THE COLOR.
>> THIS IS REALLY STRIPPED.
A LITTLE IODINE.
NOW, IF THIS WAS COVERED WITH
FOIL...

>> THERE WE GO.
>> IT WON'T HAVE AS MUCH CHLOROPHYLL IN IT.
>> WAS THIS THE GERANIUM THAT WAS COVERED, THE LEAF THAT WAS COVERED IN ALUMINUM, AND THAT ONE WAS NOT?
>> WAS NOT.
>> SO LET'S TRY THIS AND SEE --
>> Greenwood: SO THEN OUR PREDICTION WOULD BE THAT THIS WOULD BE WHAT IF IT'S COVERED? DOES IT CONTAIN STARCH OR NOT CONTAIN STARCH?
>> IT WOULDN'T CONTAIN AS MUCH STARCH.
>> IT WOULDN'T CONTAIN AS MUCH BECAUSE OF THE LACK OF LIGHT.
>> WE EXPECT THAT THE GREEN SHOULD TURN BLACK, AND THE WHITE PART SHOULD STAY JUST STAINED.
>> LOOKS DARKER.
>> THAT'S TURNING.
>> FASTER, TOO.
>> LOOK AT HOW BLACK THAT IS.
>> OH, YEAH, LOTS OF STARCH.
>> Greenwood: THE STARCH TEST SHOWS US THAT LEAVES FROM PLANTS GROWING IN THE LIGHT DO CONTAIN STARCH.
BUT PLANTS GROWING IN THE DARK DO NOT CONTAIN STARCH.
>> NOW LET'S GO BACK TO THE GARDEN IN THE WOODS IN FRAMINGHAM, MASSACHUSETTS WHERE CHERYL LOWE EXPLAINS WHAT PLANTS DO WITH THE SUGAR THAT THEY MAKE.
>> Lowe: THE SUGARS AND STARCH THAT A PLANT PRODUCES OR MAKES IS USED IN A NUMBER OF DIFFERENT WAYS.
IT'S USED TO PRODUCE MORE CELLS SO THAT THE PLANT CAN GROW.
IT'S USED AS ENERGY TO TRANSPORT NUTRIENTS FROM THE ROOTS UP TO THE LEAVES OR OTHER MATERIALS FROM THE LEAVES DOWN TO THE

ROOTS.
IT'S USED TO PRODUCE FRUIT OR
FLOWERS, ALL THE THINGS THAT A
PLANT NEEDS.
FOR THOSE OF US THAT GROW
PLANTS, WE'RE ALWAYS CONCERNED
ABOUT THE THINGS THAT A PLANT
NEEDS IN ORDER TO GROW WELL.
WE CAN ADJUST THE SOIL BY ADDING
NUTRIENTS TO IT IF WE NEED IT.
WE CAN CHOOSE THE PLANTS THAT
ARE APPROPRIATE FOR A CERTAIN
AMOUNT OF LIGHT.
GARDENERS ARE VERY GOOD ABOUT
WATCHING WATER TO MAKE SURE THAT
A PLANT GETS ENOUGH.
BUT WE REALLY DON'T THINK ABOUT
THE CARBON DIOXIDE THAT A PLANT
NEEDS TO GROW.
THE CARBON DIOXIDE THAT'S
CRUCIAL TO THE PHOTOSYNTHESIS
PRODUCTS IS ACTUALLY THE SOURCE
FOR MOST OF THE MASS THAT YOU
SEE IN SOMETHING LIKE THIS
LARGE TREE BEHIND ME,
THAT WHAT REALLY CREATES THE
MASS, WE ALWAYS ASSUME IT COMES
FROM THE SOIL OR SOMETHING
SOLID, BUT IT'S THE CARBON
DIOXIDE IN THE AIR THAT REALLY
PROVIDES THAT MASS.
>> WHETHER WE'RE TALKING ABOUT A
FLOWER OR A TREE, THE PLANT HAS
MADE ITS STEM, LEAVES, AND
FLOWER, OR TRUNK, BARK, AND
BRANCHES -- ALL OF ITS PARTS --
USING SUGAR AS THE BASIC
BUILDING BLOCK.
AND TO MAKE THIS SUGAR, IT USED
CARBON DIOXIDE FROM THE AIR AND
WATER FROM THE SOIL.
BUT REMEMBER, WITHOUT LIGHT
ENERGY AND CHLOROPHYLL, A PLANT
COULD NOT PHOTOSYNTHESIZE AND
COULD NOT MAKE SUGAR.
HOW AMAZING TO THINK THAT
SOMETHING THIS BIG, AS BIG AS A
TREE, OWES ITS GROWTH TO A GAS

IN THE AIR, WATER IN THE SOIL,
AND LIGHT.
BUT DOES THE PLANT USE ALL OF
THE VISIBLE LIGHT ENERGY?
IF I KEPT A PLANT UNDER A GREEN
LIGHT, WOULD IT PHOTOSYNTHESIZE
BETTER THAN IF I KEPT IT UNDER A
RED LIGHT?
WHY OR WHY NOT?
AND WHAT WOULD A PLANT LOOK LIKE
UNDER A GREEN LIGHT?
UNDER A RED LIGHT?
DESCRIBE WHAT HAPPENS WHEN LIGHT
PHOTONS REACH THE PLANT.
IT WAS IN THE 19th CENTURY,
IN GERMANY, THAT
THEODORE ENGELMANN
EXPERIMENTED WITH
PHOTOSYNTHESIS.
THEODORE ENGELMANN,
A 19th CENTURY SCIENTIST,
DEVISED AN INGENIOUS WAY OF
FINDING OUT WHICH COLORS OF
LIGHT ARE MOST IMPORTANT FOR
PHOTOSYNTHESIS.
HE PLACED LONG STRANDS OF GREEN,
PHOTOSYNTHESIZING ALGAE TOGETHER
WITH OXYGEN-LOVING BACTERIA
UNDER A MICROSCOPE.
ENGELMANN REASONED THAT SINCE
OXYGEN IS A BY-PRODUCT OF
PHOTOSYNTHESIS, OXYGEN-LOVING
BACTERIA WOULD MIGRATE TO THE
PARTS OF THE ALGAE WHERE THE
MOST OXYGEN WAS BEING PRODUCED.
ENGELMANN THEN ILLUMINATED THE
ALGAE WITH DIFFERENT COLORS OF
LIGHT FROM A PRISM.
SOME PARTS OF THE ALGAE RECEIVED
RED LIGHT, SOME YELLOW, SOME
GREEN, SOME BLUE, AND SOME
VIOLET.
THE RESULTS WERE STARTLING.
THE GREATEST NUMBER OF
OXYGEN-LOVING BACTERIA
CONGREGATED AROUND THE PARTS OF
THE ALGAE ILLUMINATED WITH RED
LIGHT.

THE NEXT AREA WAS IN THE VIOLET REGION.
THERE WERE VERY FEW BACTERIA IN THE REGION OF THE ALGAE ILLUMINATED BY YELLOW-GREEN LIGHT.
ENGELMANN'S ELEGANT EXPERIMENT SHOWED THAT RED AND BLUE-VIOLET LIGHT IS USED BY ALGAE FOR PHOTOSYNTHESIS.
ENGELMANN'S WORK ILLUSTRATES THAT PHOTONS OF LIGHT IN THE RED AND VIOLET REGIONS OF THE VISIBLE SPECTRUM ARE ABSORBED BY CHLOROPHYLL AND USED IN PHOTOSYNTHESIS.
THE GREEN-YELLOW LIGHT IS REFLECTED.
THIS EXPLAINS WHY MOST PLANTS APPEAR GREEN IN COLOR TO OUR EYES.
AS WE SAW EARLIER, NOT ALL PLANTS HAVE COMPLETELY GREEN LEAVES, ALTHOUGH THEY ALL CONTAIN GREEN CHLOROPHYLL.
THESE LEAVES HAVE AREAS WITHOUT CHLOROPHYLL, AND THEREFORE WE DON'T SEE THOSE AREAS AS GREEN.
RATHER, THOSE AREAS APPEAR WHITE OR YELLOW.
THESE TYPES OF LEAVES ARE KNOWN AS VARIEGATED.
SOMETIMES THE GREEN OF THE CHLOROPHYLL IS MASKED BY OTHER PIGMENTS.
BUT REMEMBER, ONLY WHEN WE SEE WHITE OR YELLOW ON PLANT LEAVES, DO WE KNOW THAT THERE IS NO CHLOROPHYLL PRESENT,
AND THEREFORE, NO PHOTOSYNTHESIS GOING ON IN THESE AREAS.
>> TODAY WE HAVE SEEN THAT PLANTS PHOTOSYNTHESIZE MAKING SUGAR IN THEIR LEAVES.
A SUGARY SOLUTION FLOWS TO ALL AREAS OF THE PLANT -- ROOTS, STEM, SEEDS.
AND IN SOME OF THESE PLACES, THE

SUGAR IS CONVERTED TO STARCH AND STORED FOR LATER USE BY THE PLANT.
THIS IS WHY WE FOUND STARCH IN OUR BEAN SEED.
THE SUGAR MADE IN THE LEAVES WAS PASSED TO THE SEED, AND THERE IT WAS CONVERTED TO STARCH.
>> SUGAR IS NOT ALWAYS STORED IN SEEDS AS STARCH.
IN SOME SEEDS, SUCH AS SUNFLOWER SEEDS, SUGAR IS CONVERTED TO OIL.
THIS IS THE SOURCE FOR THE SUNFLOWER OIL WE USE IN COOKING.
IN POTATO PLANTS, SUGAR MADE IN THE LEAVES TRAVELS DOWN THE STEM AND IS STORED AS STARCH IN THE TUBER, OR POTATO, THAT WE EAT.
>> WHEN A PLANT NEEDS THE FOOD IT HAS STORED, IT IS RECONVERTED AND SENT TO THE GROWING PARTS OF THE PLANT.
SO IN THE NORTHERN UNITED STATES, IN THE SPRING, WE TAKE ADVANTAGE OF THIS PHENOMENON BY TAPPING THE TRUNKS OF MAPLE TREES AND COLLECTING THE SUGARY SAP FROM WHICH WE MAKE MAPLE SYRUP.
>> Jones: PLANTS NEED LEAVES FOR PHOTOSYNTHESIS.
GENERALLY THIS MEANS THAT CONIFERS, EVERGREENS, ARE CAPABLE OF PHOTOSYNTHESIZING YEAR ROUND.
PLANTS IN MORE TROPICAL CLIMATES ALSO PHOTOSYNTHESIZE YEAR ROUND.
BUT IN NORTHERN DECIDUOUS WOODLANDS, WHEN FALL ARRIVES, WE NOTICE A DRASTIC CHANGE IN LEAF COLOR.
AS THE DAYS GET SHORTER, THERE IS LESS LIGHT ENERGY FOR THE TREES, THE TEMPERATURE DROPS, AND THE LEAVES STOP PRODUCING CHLOROPHYLL.
AS THE GREEN CHLOROPHYLL

DISAPPEARS, THE ORANGE AND
YELLOW PIGMENTS, WHICH ARE
NORMALLY MASKED BY THE
CHLOROPHYLL, ARE EXPOSED.
THE USEFUL SUBSTANCES FROM THE
BREAKDOWN OF CHEMICALS IN THE
LEAF, SUCH AS CHLOROPHYLL ARE
PASSED INTO THE TREE.
GRADUALLY, A LAYER OF CELLS IS
FORMED AT THE BASE OF THE LEAF,
AND THIS LAYER PREVENTS FURTHER
MOVEMENT OF SUBSTANCES INTO OR
OUT OF THE LEAF.
THE LEAF WITHERS AND DIES, AND
WILL EVENTUALLY FALL FROM THE
TREE.
LEAF DEVELOPMENT, AS WELL AS
LEAF FALL, OCCUR IN RESPONSE TO
ENVIRONMENTAL FACTORS, INCLUDING
THE AMOUNT OF DAYLIGHT.
FLOWERING IN SOME PLANTS IS ALSO
INFLUENCED BY THE LENGTH OF THE
DAY, AND THEREFORE THE AMOUNT OF
AVAILABLE LIGHT.
THIS RESPONSE TO LIGHT ENSURES
THAT PLANTS FLOWER IN THE RIGHT
SEASON.
BECAUSE OF THEIR RESPONSE TO
LIGHT, PLANTS ARE IN TUNE WITH
THE SEASONS.
IN A LATER WORKSHOP, WE'LL
EXPLORE THE SEASONS, AND THE
CAUSES OF THE DIFFERENCES IN DAY
LENGTH THAT ARE SO CRUCIAL TO
LIFE ON EARTH.
>> TODAY WE LOOKED AT THE
RELATIONSHIP BETWEEN LIGHT AND
PLANTS.
WE SAW THAT MOST SEEDS WILL
BEGIN TO GROW WITH OR WITHOUT
LIGHT.
PLANT CELLS IN THE LIGHT CONTAIN
A CHEMICAL CALLED CHLOROPHYLL.
AND CHLOROPHYLL ABSORBS LIGHT
ENERGY.
LIGHT ENERGY IS TRANSFORMED INTO
CHEMICAL ENERGY IN SUGAR DURING
THE PROCESS OF PHOTOSYNTHESIS.

AND THE RAW MATERIALS USED IN
PHOTOSYNTHESIS FOR MAKING SUGAR
ARE CARBON DIOXIDE AND WATER.
AND THE SUGAR IS STORED AS
STARCH OR OIL IN THE PLANT.
>> WE ALSO SAW TODAY THAT WHILE
PLANTS ARE BUSILY MAKING SUGAR
FOR THEMSELVES, THEY ARE ALSO
PRODUCING OXYGEN.
WITHOUT THIS OXYGEN, LIFE ON
EARTH AS WE KNOW IT WOULD NOT
EXIST.
WE CLEARLY DEPEND ON PLANTS FOR
FOOD, BUT WE ALSO DEPEND ON THEM
FOR MAINTAINING OUR ATMOSPHERE.
IN THE NEXT PROGRAM, WE'LL
EXPLORE THE IMPORTANCE OF PLANTS
TO ANIMALS AS WE STUDY ENERGY
AND ECOSYSTEMS.
>> Jones: DON'T FORGET TO CHECK
OUT OUR WEB SITE FOR ADDITIONAL
INFORMATION, ACTIVITIES AND
DISCUSSIONS WITH YOUR
COLLEAGUES.
THE ADDRESS IS
www.learner.org/
channel/workshops/sheddinglight.
AND IF YOU DON'T HAVE ACCESS TO
THE WEB, YOU CAN SHARE YOUR
THOUGHTS WITH US BY E-MAIL, FAX
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>> FUNDING FOR THIS PROGRAM IS
PROVIDED BY THE ANNENBERG
FOUNDATION/CORPORATION FOR
PUBLIC BROADCASTING ELEMENTARY
AND HIGH SCHOOL PROJECT FOR
MATHEMATICS AND SCIENCE.